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TeamSTEPPS Communication and in Situ Simulation Training to Improve Individual and Team Performance During Handoff of the Immediate Post-Operative Cardiovascular Surgical Patient

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TeamSTEPPS communication and *in situ* simulation training to improve individual and team performance during handoff of the immediate post-operative cardiovascular surgical patient.

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This thesis has been examined and approved by the following members of the thesis committee.

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Abstract

The aim of this pilot study was to identify if establishing a reliable framework for consistent use of TeamSTEPPS communication would improve the team communication and performance during the critical handoff of the cardiac surgical patient from the OR team to the ICU team. Breakdown in handoff communication has been attributed as the cause of adverse health events, delays in treatment, inappropriate treatment, increased length of stay, and increased costs and inefficiencies from rework. Standardizing handoff communication is a Joint Commission National Patient Safety Goal, and immediate postoperative cardiac surgical patients are a high-risk population needing consistently high quality communication at handoff. After education was done on TeamSTEPPS communication, *in situ* simulation was the method used to observe the cardiovascular surgical team's handoff of care to the ICU team. Despite an improvement from pre- to post-simulation, a statistically significant difference was not shown in the teams' perception of communication and performance. Skills necessary for team members to contribute to highly reliable, interdisciplinary teams can be attained through high-fidelity *in situ* simulation to ensure patient safety, but individual attitudes and behaviors can adversely affect team cohesion and outcomes. Individual team members have key roles in assuring effective team communication and performance through the transfer of critical information during handoffs. Training through simulation leads to the appreciation that the technical skills of team members may be secondary to the non-technical skills, such as communication, in the performance of highly reliable teams.

CHAPTER I

INTRODUCTION

Decreasing medical error and adverse patient events is a major focus in health care today. There are many interventions that have been applied from the patient up to the system level, some backed with stronger research than others. What has been a focus, pushed by many governmental agencies and regulatory bodies, is that health care needs to be safer. The Institute of Medicine (IOM) (1999) report “To Err is Human: Building a Safer Health System” estimated that more hospitalized Americans die each year from “preventable medical errors” than from “common threats” like motor vehicle accidents, breast cancer, and AIDs (p. 1). The World Health Organization (2002) attributed the “complex processes, technologies and human interactions” within the health care system as not only bringing significant benefits but also “inevitable risk of adverse events” (p. 1).

Highly reliable care in interdisciplinary teams is crucial to ensure patient safety. Simply establishing a team does not ensure it will function effectively. Effective communication within teams is essential. The handoff of patient care from one team to another carries a high risk of adverse events and is a time of great risk to the patient. There are communication styles that can be used within a team and between teams to ensure safe and effective team work. Closed-loop communication, call outs, situational awareness, and shared mental model are types of effective communication styles that when used within and between teams can ensure highly reliable and safe patient handoff. However, these communication styles are typically not taught in health care educational programs.

Problem Statement

Communication within and between teams is essential to patient care and safety. There are three areas that contribute to communication and teamwork failure. They are role specializations, incentives that support individuals rather than team performance, and educational programs that do not teach interdisciplinary teamwork. The highest risk of adverse events occurs during the handoff of patient care from unit to unit, team to team, or nurse to nurse. A specific risk occurs during the immediate post operative time of the cardiovascular surgical patient. The critical handoff of this patient population not only involves the relocating of the patient from one chaotic environment to another but also requires the transfer of care from one team to another. These teams may never consist of the same individuals, making role identification difficult. Identified roles and responsibilities are key to safe patient transition from one team and location to another.

Background

Teams

Many health care teams do not have consistent membership or leadership. Miller, Riley, Davis, and Hansen (2008) found that a possible "381 million potential teams" could be "constituted from their core staff that respond to an emergency cesarean delivery" in their community hospital (p. 106). A similar situation exists at the hospital where this research took place. Each Operating Room (OR) team consists of at least an OR circulating nurse, a Certified Registered Nurse Anesthetist (CRNA), a surgeon, and an anesthesiologist. Depending on the day some or all of the OR team will transport the patient to the Intensive Care Unit (ICU). The surgeon at times arrives in the ICU prior to the patient to enter post-op orders and discuss the condition of the patient with the family. During the day shift hours, Monday through Friday, there is an OR aide who also assists in transport of the patient to the ICU. This individual's sole responsibility is to switch the cables, which allows the patient's vital signs to display from the transport monitor to the bedside monitor once in the ICU room. The two constant participants in the OR team for transport to ICU are the CRNA and the circulating nurse. The circulating nurse typically brings the patient chart and the cooler with any blood products for the patient. The patient is manually ventilated by the CRNA who also assists the circulating nurse in pushing the bed, monitor, and IV poles with pumps.

The ICU receiving team consists of two registered nurses who are trained in the care of the immediate post-op cardiovascular surgery patient and a respiratory therapist (RT). The RT's primary responsibilities are to connect the patient to the ventilator with the ordered settings and to check the patient's breathe sounds and the endotracheal tube position. The primary ICU nurse assumes care of the patient in the ICU. The resource nurse assists the primary nurse in settling the patient once in ICU. Settling consists of hooking the patient up to the bedside monitor, zeroing the lines to ensure accurate data, connecting chest tubes to suction and monitoring for patency, checking and/or starting IV medication based on the physician orders and patient vital signs, obtaining initial lab work, and assessing and performing interventions based on the physician orders and patient needs. Depending on the stability of the patient, the settling process can take anywhere from 30 minutes to longer than an hour.

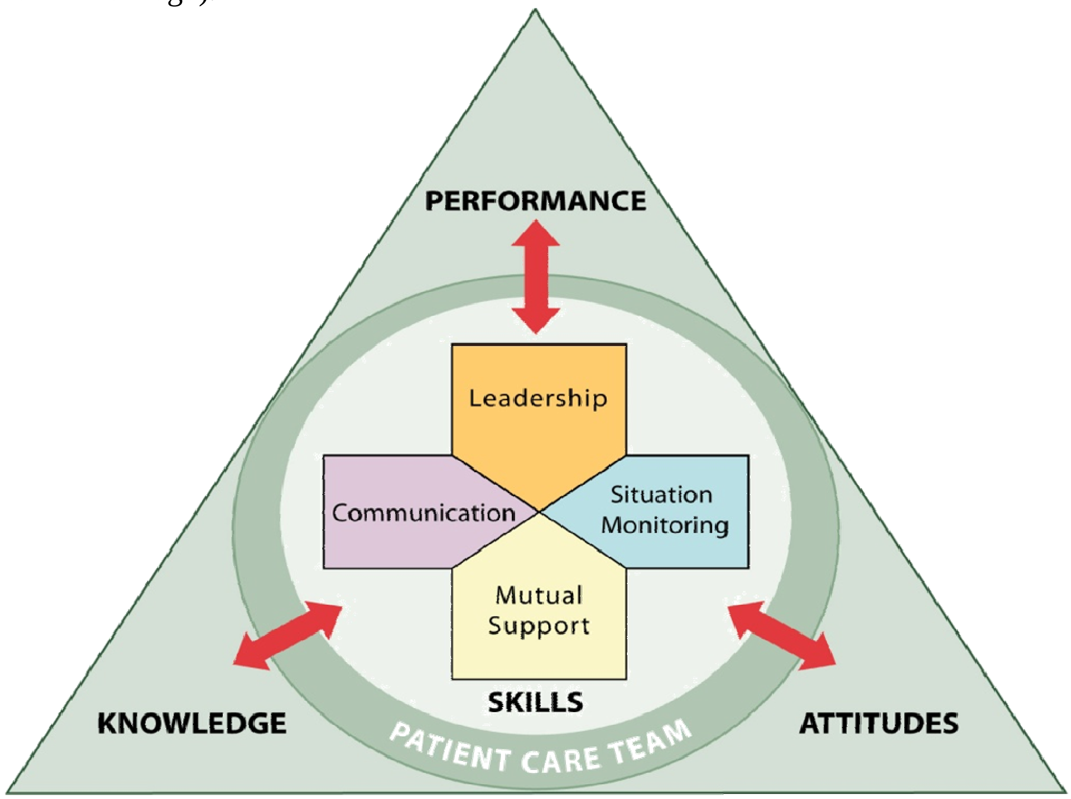
Past Work

The hospital had been actively involved in an assessment of the critical handoff of cardiovascular surgical patients between the OR and the ICU, because these patients bypass recovery and are transferred directly to the ICU. Through a series of simulated *in situ* sessions that were held between February of 2008 and December 2008, information was gathered to determine the most frequent reasons for patient errors occurring during transfer, handoff, and settling of the postoperative cardiovascular patient. Communication was found to be the key factor in most adverse patient events.

It was observed during the simulated handoffs of these patients coming from the OR to the ICU that communication between staff members was random, chaotic, and inconsistent. In late 2008, the hospital adopted the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) initiative (Agency for Healthcare Research & Quality (AHRQ), TeamSTEPPS: National Implementation, 2011) and many of the hospital's ICU staff and cardiovascular surgical team members were educated on this teamwork program. The education consisted of presentations by key leaders, including the critical care nurse clinician, the lead cardiovascular surgeon, the ICU nurse manager, and others. TeamSTEPPS communication concepts and how they could be used within the ICU environment to improve patient safety were presented. Quick reference books on TeamSTEPPS where handed out to those who attended. These presentations were not mandatory so the content was also discussed at staff meetings and other ICU committee meetings.

TeamSTEPPS is an evidence-based "teamwork system" to improve communication and teamwork skills "among health care professionals" (AHRQ, TeamSTEPPS: National Implementation, 2011, para. 2). In collaboration with the Department of Defense's Patient Safety Program, the Agency for Healthcare Research and Quality (AHRQ) developed TeamSTEPPS and encouraged health care organizations to incorporate it into their culture as a way to improve patient safety. More than "20 years of research" was used in conjunction with "lessons learned during the application of teamwork principles" (AHRQ, TeamSTEPPS: National Implementation, 2011, para. 2). This program uses principles of teamwork from the aviation industry's crew resource management that have been adapted for health care. The teamwork skills include leadership, communication, situation monitoring, and mutual support. By learning and building on these four teamwork skills, the team's performance, knowledge, and attitudes are enhanced (see figure 1).

Figure 1
The TeamSTEPPS triangle logo, demonstrating basic concepts related to teamwork training. (obtained from AHRQ, TeamSTEPPS: National Implementation, 2011, About the TeamSTEPPS Logo).



To build on the TeamSTEPPS training, the critical care nurse clinician, the ICU educator, and the education specialist conducted further high-fidelity *in situ* simulations in the ICU to train specifically on the communication between the OR and ICU teams. Because communication breakdowns can be a patient safety issue, the focus was on improving communication skills. Operating room and ICU teams were filmed in a simulated patient scenario, using the "Sim Man" mannequin set up as a post operative cardiovascular surgical patient. The scenario included critical events requiring the staff to react and communicate. Observations were focused on the communication during this transition. In the debriefings, what went well, what could have gone better, and what individuals would do differently next time was discussed. The following findings from the debriefings are the most common behaviors, process issues, and observations that impaired effective team performance and communication:

- The circulating nurse's report sometimes came before the airway, breathing, circulation (ABCs) had been established by the ICU RN.
- More than one conversation was occurring at a time; there was a need to decrease side conversations.
- The primary ICU RN was responsible for completing multiple tasks and was unable to process information given by CRNA/circulating nurse during this time.
- The OR staff perceived the focus was not on their report. They did not feel as if what was being said was formally acknowledged. This indicated the need to create a "sterile cockpit," meaning that no one interrupts the nurses during the report. It also indicated the need to use names/roles and eye contact during report.
- It was necessary to move away from the bedside to conduct handoff report since both parties focused on the patient during the handoff and not on the report.
- The process for handoff report needed to be identified and structured. A format such as SBAR was suggested.
- A well established and reliable framework was necessary so that when distractions/deviations occurred, the process worked to assure communication and safety.

- Nurses felt that they could not listen to report while focusing on exchanging cables and untangling lines.
- There was a need for more closed-loop communication to occur in the handoff.
- The patient ID needed to be added to the report sheet coming from OR.
- The OR nurses did not know what the ICU nurses needed to hear in report.
- The Anesthesiologist did not know who was in charge in the patient's room.
- The ICU staff stated that the surgery staff seemed to leave the room too fast.
- No one acknowledged that they had received report in the patient's room.
- The report needed to include the procedure done, specific surgical events that might affect care, the type of valve placed, etc.

A group of engaged individuals who function on the cardiovascular surgical team met to discuss what recommendations could be put forth to improve the identified barriers to effective team communication and function. Table 1 shows the behaviors and processes identified as needing improvement, the recommendations put forth, and whether the recommendations were completed. Note that all the recommendations except one were completed and only one recommendation was not being consistently performed in practice. Based on this analysis, the critical care nurse clinician and the education specialist identified educational content to develop an e-learning module and training video on the ideal handoff.

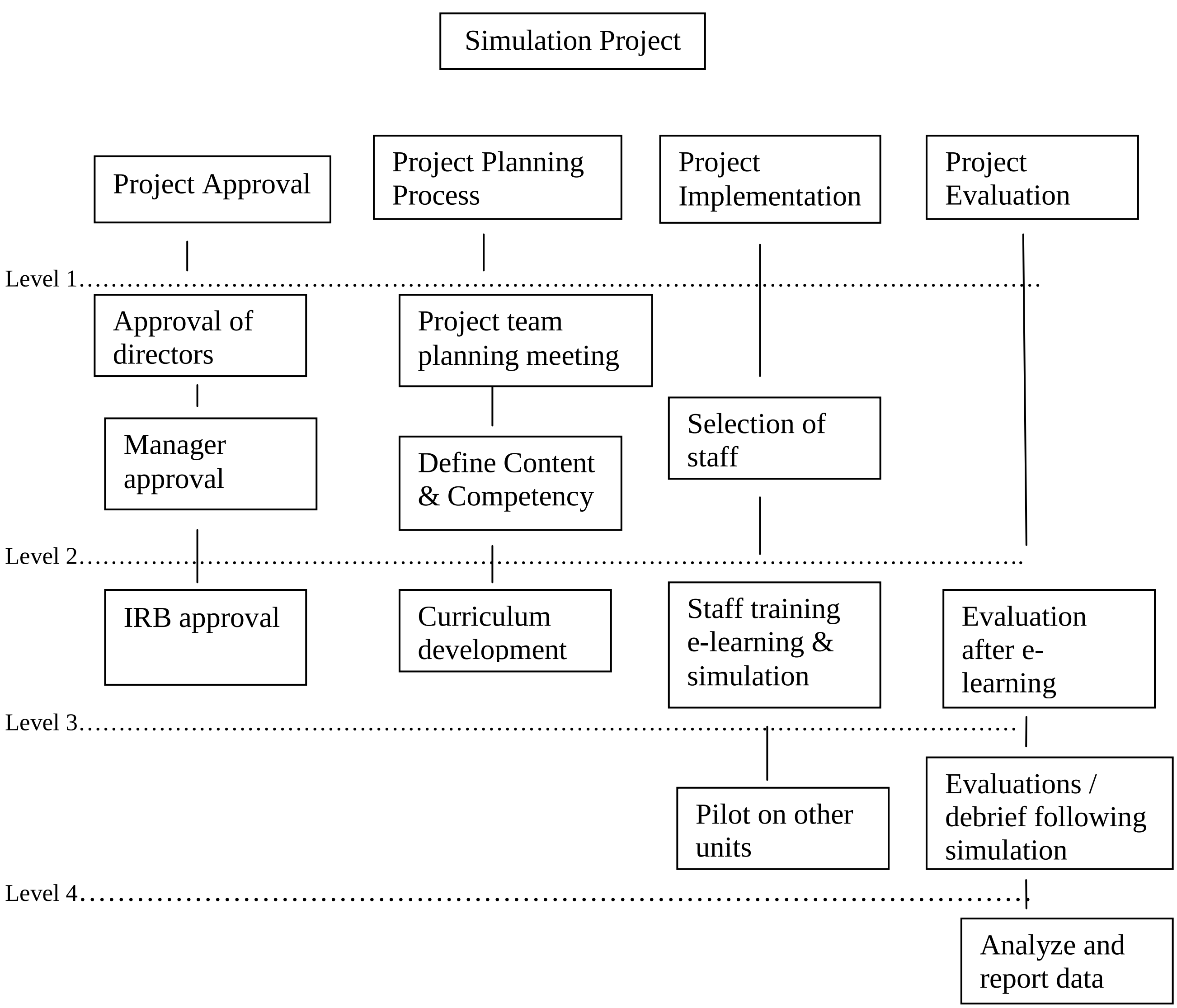
Table 1.
Behaviors and Process Changes Improved From Initial Cardiovascular Handoff Simulation.

Behaviors/Processes	Recommendation	Completed
Someone specific needs to handle the monitoring lines and cables.	OR aide assists in transport of the patient from OR to ICU to manage the monitoring lines and cables with every case.	No, OR aide only available during the day hours during the week.
Inconsistencies as to when OR contacted ICU that the procedure was nearing end. OR did not know that an ICU nurse needed to be called in from home at times.	OR to call ICU no less than one hour ahead of ETA to allow for on-call nurse to be called in from home	Yes, consistent practice.
Inconsistencies in the handoff report given.	Use of SBAR communication for handoff report.	Yes, consistent practice.
ICU RN was noted to experience task overload and was unable to process information from the OR staff. The OR staff's perception was there was little focus on their report.	ICU nurse and RT will establish initial ABCs before report is received from the OR staff.	Yes, consistent practice.
More than one conversation occurred at a time.	Close-loop communication and call outs are to be used during this handoff of care.	Yes, with inconsistent practice.
No arm band on patient when transferred to ICU.	The patient will have an identification band on 100% of the time on transfer to ICU.	Yes, practice consistent.
Report sheet was not complete, information left out that was needed by the ICU team.	The report sheet will be complete when received by the ICU staff.	Yes, practice consistent.

In 2009, the cardiovascular handoff simulation work was presented to the hospital's Cardiovascular Surgery Quality Committee, led by a cardiovascular surgeon. The committee approved the recommendation that cardiovascular *in situ* simulation should be required of all cardiovascular surgical team staff to assure team members communicate effectively and consistently the significant information needed during handoffs. These simulations were expected to help establish a reliable framework for the consistent use of TeamSTEPPS communication and to improve patient safety during handoff.

The *in situ* scenario was redesigned by a group of critical care and operating room staff, with input from the cardiovascular surgeons and the critical care nurse clinician. The goal was to continue to replicate the typical cardiovascular surgical patient, with focus on critical communication and team performance during the handoff. Physician to physician communication was included in the scope of project. A simulation project plan was developed including project approval, process planning, implementation, and evaluation (see Figure 2).

Figure 2
Simulation project plan, showing four levels of completion.



Purpose

The two primary purposes of this pilot study are listed below.

1. To improve team communication during the critical handoff of the cardiovascular surgical patient from the OR to the ICU team.
2. To establish a reliable framework for consistent use of TeamSTEPPS communication methods to improve patient safety.

Significance

The significance of this work lies around the team's ability to communicate effectively during a high risk handoff. This effective communication will transfer into other handoff situations. Individual skills will be improved by this work, enhancing interdisciplinary team performance. By undergoing team training, individuals are expected to acquire behaviors allowing them to function effectively as part of an interdependent team (Salas, Burke, & Cannon-Bowers, 2000, p. 340).

Assumptions

Three assumptions were made prior to implementation of this pilot study. They are:

1. Participants of the cardiovascular surgery handoff are highly knowledgeable and skilled in the technical work they do.
2. Participants' intentions are good and in pursuit of patient safety.

3. The patient's best interest is the primary reason the participants do what they do.

Research Questions

Three research questions are addressed in this pilot study. They were:

1. Does educating team members on effective communication styles through e-learning improve their perception of team communication and performance?
2. Does educating team members on TeamSTEPPS communication through e-learning improve their perception of their ability to use these communication styles in clinical situations?
3. Using the Mayo High Performance Teamwork Scale (Malec, et al., 2007), does the team perform consistently after receiving education through e-learning on effective communication styles?

Definition of Terms

For the purpose of this paper, the following terms were defined for clarity and understanding.

Handoff – The "transfer and acceptance of patient care responsibilities achieved through effective communication" [Joint Commission Center for Transforming Healthcare (The JC), Facts about Hand-Off Communications, 2011, para. 1].

Medical error and adverse event - These definitions were taken from the IOM's (1999) landmark report on patient safety, "To Err is Human: Building a Safer Health System." A medical error "is the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim" (p. 1). An adverse event is an "injury caused by medical management rather than by the patient's underlying condition" (p. 1).

High-fidelity simulation - The level to which the "simulation replicates the clinical, physical and psychological reality of the real-life clinical setting" (Davis, Miller, & Riley, 2008, para. 1).

In situ simulation - The strategy of training that takes place on a patient care unit versus in a laboratory. The focus of in situ training is to "train individuals to become effective team members through focused communication and team behaviors" (Miller, Riley, Davis, & Hansen, 2008, p. 106). The scenario was developed to replicate the real-life clinical situation.

Limitations

There were three limitations that may affect the generalizability of the pilot study. The limitations are:

1. Variation in the OR and ICU teams. Although *in situ* simulations were scheduled during the day, depending on the census, patient acuity level, vacations, and ill calls. The membership of each team varied composition.
2. Simulation limitations. High-fidelity simulation allows for most real-life clinical situations to be replicated, but there are some limitations to simulation that may affect their participants' perceptions of the event.
3. Team member's engagement. The engagement of the team members is a factor that cannot be controlled. The individual's engagement in this work can affect the whole team's ability to function effectively.

CHAPTER II

REVIEW OF LITERATURE

Lapses in complete, accurate communication from one caregiver to another when care of a patient is handed off are a concern that can affect the safety and quality of patient care. This chapter contains information on patient safety including handoffs in health care, communication between individuals and teams, and the use of simulation in health care. The review of literature is organized into four sections. They are patient safety, handoffs, communication, and simulation.

Patient Safety

President Clinton developed The Advisory Commission on Consumer Protection and Quality in the Health Care Industry in 1996 to "advise him on changes occurring in the health care system" and offer recommendations that "promote and assure health care quality and value" (Advisory Commission, 1998, para. 2). From this commission came a statement on the purpose of the health care system, which was to "continuously reduce the impact and burden of illness, injury, and disability, and to improve the health and function of the people of the Unites States" (Advisory Commission, 1998, para. 3). Commission cited references to the number of iatrogenic adverse events that have caused permanent disability and death, along with literature that showed a twofold rise in deaths due to medication errors in a ten-year period. This report was a call to action for the health care community.

The IOM has also challenged health care organizations to make safety one of their organizational goals. By developing a “culture of safety” within their “workforce and processes” the safety and reliability of patient care will be improved (IOM, 1999, p. 4). To ensure safe practices at the delivery level, health care organizations need to incorporate safety principles that are understood, such as “standardizing and simplifying equipment, supplies, and processes” as well as “enabling care providers to avoid reliance on memory” (IOM, 1999, p. 4). Helmreich and Davies (2004) compared the similarities in the struggles for safety in health care with those in aviation, challenging organizations to define a clear policy around human error. Non-compliance should be unacceptable, but errors should be accepted and not punished so they are reported and thoroughly evaluated (Helmreich & Davies, 2004). This type of error reporting and research is part of what makes a just culture (Helmreich & Davies, 2004).

The Just Culture Community was founded through the partnership of the health care and aviation industries. Just Culture supports system safety by “facilitating open communication within the organization, while working within a system of accountability that supports safe behavioral choices among staff” (About Our Community, 2011, para. 1). By viewing patient safety at a systems level, it is easy to recognize that many errors and adverse events are a result of imperfect “humans working in poorly designed care systems” (Woodward, Mytton, Lemer, Yardley, Ellis, & Rutter, 2010, p. 480). Saxton, et al. (as cited by Miller, Riley, Davis, & Hansen, 2008) “reported that organizational culture plays a major role in guiding individual behaviors and team performance” (p. 110-111).

Engaging patients in their own care is another way to achieve a safety oriented health care system. Disclosure of errors is patient-centered care with a focus on safety. There are consistent reports that patients want to be told when an error has occurred. This makes sense as patients who experience "disability as a result of errors pay with physical and psychological discomfort" (IOM, 1999, p. 3).

The health care community has been challenged by government and local agencies to make safety a top priority. Building safety into health care organizations' strategic plans, constructing safety into the culture, and engaging patients in their own care are some of the primary ways to guarantee safety is at the center of care delivery.

Handoffs

The passing of necessary and critical patient information from one caregiver to the next or from one team to another has long been a challenge in health care. The breakdown in handoff communication has been attributed as the cause of adverse health events, and has lead to delay in treatment, inappropriate treatment, increased length of stay, and costs and inefficiencies from rework (The JC, Storyboards for the Handoff Communications Project, 2009). Communication breakdown can occur as the result of inaccurate or incomplete patient information, lack of sender or receiver knowledge of the patient's condition, information that is not up-to-date (e.g., laboratory and other test results), inability to clarify information, and role ambiguity. The sender and receiver in a handoff have different responsibilities and expectations. The sender, "caregiver transmitting information," must communicate needed information to the receiver, "caregiver accepting information" (The JC, Facts about Handoff Communications, 2011). The information transmitted and received must be sufficient for the receiver to safely care for the patient. However, if there is a disconnect between the critical information the receiver actually receives and the critical information they actually need, an imbalance occurs that creates a patient safety concern (see Figure 3).

Figure 3
Handoff communication balance (adapted from The JC, Storyboards for the Handoff Communications Project, 2009, slide 5).

Miscommunication can occur at any provider level in health care, including at the level of physician to physician communication. Solet, Norvell, Ruton, and Frankel (2005) found four major barriers to effective handoffs between physicians: "physical setting, social setting, language and communication barriers" (p. 1096). They also found that "standardizing the patient handoff and teaching medical students proper handoff methods," was likely to ensure patient safety by decreasing errors (Solet, Norvell, Rutan, & Frankel, 2005, p.1098).

The variability in handoff styles can also lead to error. In a quasi-experimental study, written communication, verbal communication, and a combination of the two were tested showing a 96% recall rate on the combined handoff compared to a 58% or less recall rate for written or verbal communication alone (Pothier, Monteiro, Mooktiar, & Shaw, 2005). In a survey done by the AHRQ (2009), almost half of the 74,345 nurses and physicians who responded reported that "important patient care information is often lost during shift changes" (AHRQ, Hospital Survey on Patient Safety Culture: 2009, p. 29).

The causes of human errors in the ICU have also been studied. Intensive care units typically are fast paced work areas with much multitasking and interruptions occurring for providers. When errors were investigated in a medical surgical ICU at a university hosptial, 37% of the 554 errors were related to verbal communication between physicians and nurses (Donchin, Gopher, Olin, Badihi, Sprung, & Prizon, 1995). Among their recommendations was formalizing the handoff of information during shift changes. The OR can be just as fast paced as the ICU. ElBardissi, Wiegmann, Henrickson, Wadhera, and Sundt (2008) found, in a prospective observation of cardiac surgical cases, a statistically significant correlation between the "occurrence of technical error and teamwork failures" (p. 1027). They concluded that interventions that improved teamwork and communication would improve the overall process of cardiac surgery.

The Joint Commission Center for Transforming Healthcare (The JC) is dedicated to helping health care organizations provide quality health care consistently, and handoff communication is just one area of focus. In 2006, The JC identified "a standardized approach to handoff communication" as a National Patient Safety Goal (NPSG) for hospitals (The JC, Facts about the National Patient Safety Goals, 2009, para. 4). Standardized handoff communication continues to be a NPSG today, but with more clarity around how hospitals can achieve the goal. Fairview Health Services, along with nine other health care systems, took part in The Joint Commission's (2009) initiatives to improve handoff communication. It was found that greater than "37% of the time handoffs were defective and did not allow caregivers receiving responsibility to safely care for the patient" (The JC, Facts about Hand-Off Communications, 2011, para. 1). Others have estimated up to 80% of serious medical errors are related to miscommunications between cargivers during the handoff of care (Solet, Norvell, Rutan, & Frankel, 2005, p. 1094). The answer to this problem is not simple. The JC has continued its work on handoff and has developed the SHARE acronym to assist clinicians. SHARE stands for standardize critical content, hardwire within your system, allow opportunities to ask questions, reinforce quality and measurements, and educate and coach (The JC, Facts about Hand-off Communications, 2011, para. 3). This acronym targets the specific reasons handoffs fail.

The literature strongly supports and The JC encourages the use of standardized handoff communication, including the use of a structured handoff communication tool or mnemonic during patient handoffs. Reisenberg, Leitzsch, and Little (2009) cited eighteen different mnemonics used by health care team members with Situation, Background, Assessment, Recommendation (SBAR) used 69% of the time (p. 24). A review of the literature on nursing handoffs one year later found "35% of the articles included the use of a handoff mnemonic with SBAR cited 76% of the time" (Riesenberg, Leitzsch, & Cunningham, 2010, p. 28). Modeled after the process used on nuclear submarines, SBAR "facilitates the consistant, concise exhange of information" (Runy, 2008, p. 3), especially critical ones "requiring a clinician's immediate attention and action" (IHI, 2011, para. 1). No matter what the structured communication style used, the goal is a process that clearly defines the transfer of responsibility from one cargiver to another.

Much of the handoff structure in health care was adopted from the aviation industry; the aerospace crew research project allowed pilots to improve safety, and this work has extended into health care (Helmreich & Merritt, 1998). This crossover of safety initiative stemmed from President Clinton's formation of the President`s Advisory Commission on Consumer Protection and Quality in the Health Care Industry in 1998, which made health care quality and safety a "national commitment" (Advisory Commission, 1998, para. 1).

Communication

Communication breakdowns during transitions of care were the "leading cause of sentinel events reported to The JC between 1995 and 2006" (The JC, Storyboards for the Handoff Communications Project, slide 3). Almost "80% of serious medical errors involve miscommunication" between providers during the handoff of care (Solet, Norvell, Rutan, & Frankel, 2005, p. 1095).

Elbardissi, Wiegmann, Hendrickson, Wedhera, and Sundt (2008) suggested incorporating standardized communication practices during cardiac surgery to help decrease the number of teamwork failures and technical errors that occurred during the procedure. Mazzocco, Petitti, Fong, Bonacum, Brookey, and Graham (2009) found that when teams have poor team behaviors, patients are more likely to experience death or major complications. This quantitative research study was able to make a “direct link between teamwork during the surgical case and patient outcomes” (p. 682).

Structured communication helps consistency and ensures the receiver obtains the needed information during handoff. This type of communication also helps the sender identify what information the receiver will need to safely care for the patient. Stead, Kumar, Schultz, Tiver, Pirone, and Adams (2009) found after implementing the TeamSTEPPS program including a structured communication tool, a “significant increase in patient safety culture and staff knowledge, skills and attitudes toward teamwork and communication” as well as a “reduction in the patient seclusion rate” in an Australian mental health facility (p. S128). The structured communication tool implemented was SBAR for clinical handovers, and after one month of implementation, SBAR communication was demonstrated in almost “all patient presentations at handover” (p. S129).

The nature, characteristics, and communication manners of health care teams are in general poorly understood (IOM, 1999; Burke, Salas, Wilson-Donnelly, & Priest, 2004; AHRQ, TeamSTEPPS: National Implementation, 2011). The IOM (1999) points out that the quality of communication between team members varies considerably and this variability has patient safety consequences.

Simulation

Simulation can dramatically improve the knowledge the adult learner obtains from an educational experience. Adult learners come with life experiences, assumptions, feelings, personality traits, and relationship patterns, all of which drive their actions related to learning. Knowles (1980) explained that adult learners often "learn best when they can apply what they have learned" (as cited by Fanning & Gaba, 2007, p. 115). Simulation training allows learners to go through the experiential learning cycle and partake in reflection in the debriefing process, where the majority of learning occurs. Simulation also creates a sense of safety since the environment is controlled and nonthreatening. The *in situ* simulation process typically includes four stages; briefing, simulation, debriefing, and follow up. It is well know in the simulation community that the "heart and soul" of the simulation experience occurs in the debriefing (Fanning & Gaba, 2007, p. 124).

Berkenstadt, Haviv, Tuval, Shemesh, Mergill, and Perry (2008) found in a prospective investigations that simulation-based teamwork training improved nurses' communication of crucial information during handoffs when a structured handoff protocol was integrated. This project was initiated after investigating a minor incident that occurred during a nursing shift handoff.

Kobayashi, Patterson, Overly, Shapiro, Williams, and Jay (2008) wrote about the ease of adapting simulation into a portable operation, despite some limitations from "cables and wires." Portable simulation "introduces new approaches to acute care education and research" (p. 1166). Weinstock, Kappus, Garden, and Burns (2009) found in a descriptive study that with a "self-contained mobile cart," simulation can be brought to "teams that might not otherwise benefit from the educational tool and increases the number of institutions capable of instituting simulation-based education" (p. 181).

The use of *in situ* simulation training in the patient care unit allows for the most critical clinical situations to be simulated and team performance improved. Miller, Riley, Davis, and Hansen (2008) found that *in situ* simulation training used in obstetric and neonatal emergencies was an “effective method of experiential learning that reinforces the value of becoming an expert team member” (p. 111).

Summary

Simulation offers a controlled and safe environment were many adult learners learn best. Some of the most advanced clinical situations, including those occurring on patient care units can be replicated through simulation, helping to improve communication and team work. Patient safety is now at the heart of many health care organizations’ process improvement work. The focus is often around the most high risk patient scenarios which include handoffs of care. Communication breakdowns are key contributors to adverse health events related to handoffs. Simulation is a highly effective way to improve a team’s communication during these high risk handoffs.

CHAPTER III

METHODOLOGY

Design

The design was a pilot study involving two simulations of the post operative cardiovascular open heart surgical patient transferred directly from the OR to the ICU. High fidelity, *in situ* simulation was used to evaluate the participants' perceptions of team communication and their individual use of TeamSTEPPS communication. Using findings from previous *in situ* simulation work, a new comprehensive e-learning module, incorporating a training video, was developed for the cardiovascular surgical and ICU teams. The e-learning module included TeamSTEPPS communication concepts and how they can be utilized clinically. Table 2 describes the TeamSTEPPS concepts that were included in the e-learning module, definitions of the concepts and how they can be used in practice.

Table 2
Content of e-learning module.

TeamSTEPPS Concepts	Description	Use in Clinical Practice
Briefs, huddles, debriefs	Individuals or team gathering for short discussion.	Unit report; bedside report; post code event; patient care issue needing attention.
Situational Awareness	Knowing what is going on around you.	Being aware what is going on in the unit working; being aware a code is occurring down the hall.
Shared Mental Model	Perception of, understanding of or knowledge about a situation or process that is shared among team members through communication.	Charge nurse and bedside nurse discuss patient situation and agree patient is in respiratory distress.
Effective Communication	Effective communication is complete, clear, brief and timely.	Handoff reports between two individuals where the appropriate and needed information is given.
Situation, Background, Assessment, Recommendation; SBAR	A framework for individuals to communicate information to one another effectively.	Handoff report, summary of patient situation when calling a provider.
Call Out	Used to communicate to all team members simultaneously.	During code blue, individual calls out "all clear" before delivering shock to patient.
Closed-Loop Communication	Process used to ensure that information conveyed by the sender is understood by the receiver as intended.	Telephone order is read back to the provider to ensure the information is correct.
Stop the Line	Stop and speak up when a patient safety concern is identified or questioned.	Five rights are done before medication is given and if any are not correct the medication is not given.

The training video for the team was scripted and designed to contain the desired behaviors and communication between the identified team members as described in the TeamSTEPPS e-learning module and listed in the table above (see Video 1). The scripting for the training video was as follows:

Scene

Cardiac surgery patient is rolled into ICU room from a location just outside the assigned ICU room accompanied by the CRNA, the OR nurse, the MDA, and the monitor technician.

CRNA: "This is Mr. Sim Man. I am the CRNA". This queues other team members to announce themselves and their title.

CRNA or MDA: "Respiratory Therapist the ventilator settings are Fi02...mode…respiratory rate...tidal volume…pressure support…peep…"

RT: Repeats back to the CRNA or MDA once they have entered the ventilator settings. "The ventilator settings are Fi02...mode…respiratory rate...tidal volume…pressure support…peep…"

RT: After listening to the breathe sounds… "Lung sounds are present bilaterally and the endotracheal tube secure at ___cm @ the lip."

Primary ICU nurse: "Thank you, bilateral breath sounds and airway noted."

Activity: ICU resource nurse connects chest tubes to suction.

Resource nurse: "Chest tubes are to suction"

Primary nurse: "Thanks, chest tubes are connected."

Primary ICU nurse: "CRNA (or name if known) is the patient stable so I can change to the bedside monitor?" This communication could also be done by the monitoring technician if s/he is present.

CRNA: "The patient is stable, ok to change to your monitor."

Activity: The cables are switched over to the bedside monitor and the lines leveled and zeroed.

Primary ICU nurse or monitor technician: "The patient is now on the bedside monitor, lines leveled and zeroed."

Activity on monitor: BP 115/67, MAP >60, HR 88, O2 Sat 98%

Resource RN activities: Marks chest tubes, empties foley, checks placement of oral gastric tube and hooks to suction, applies bilateral wrist restraints, secures pacer wires if present, calls for ECG, and chest x-ray.

Primary ICU RN activities: Performs quick assessment of patient, to include but not limited to breath sounds, heart tones, and pulses. Reviews IV pumps, what medications are infusing and were. Assesses chest tubes for drainage and type of drainage.

Resource RN to CRNA: "Looks like the patient is on the OR micro Neosynephrine drip, is it ok to switch to the ICU Neosynephrine drip?"

CRNA to resource RN: "Yes, the OR Neo drip has been discontinued,"

Resource RN: Starts the ICU Neo drip and hooks up to patient. "The ICU neo drip is infusing at ____mcg."

Activity on Monitor: 120/65, MAP>60, HR 72, O2 Sat 98%

Primary ICU RN to Resource RN and CRNA: "The patient looks stable, I can take report now. Resource nurse (or name if known) can you monitor the patient while I take report?"

Resource RN: "Yes"

Activity:: CRNA and Primary ICU nurse step over to the Hillrom for report. Once report is done, the CRNA finishes some of the charting, and the Primary ICU nurse goes back to the patient's bedside and huddles about the current condition of the patient and tasks that still need to be done.

CRNA to Primary ICU RN: “I am ready to go, do you have any questions?”

The training video was formatted into the e-learning module and assigned to all participants using the Learning Management System (LMS). LMS is an on-line education management system that allows electronic content development and tracking. The combined e-learning module, including the three minute video, took 15 minutes. Following completion of the e-learning session participants took part in an *in situ* simulation involving the critical hand off of a cardiovascular surgery patient. Each simulation was videotaped, and the video tape was watched by the participants in its entirety during the debriefing. The participants were asked to identify what went well, what could have gone better, and what they would do differently in the future after watching their simulation video. The TeamSTEPPS communication style used during the simulation was identified to allow further learning to occur. The video was stopped at times to discuss the behavior or communication occurring.

Video 1
Ideal handoff of care of the cardiovascular surgical patient with TeamSTEPPS communications styles identified throughout.
CV Surgical Handoff video.wmv

Setting

This pilot study was conducted at a 390-bed community, nonprofit hospital located in a suburb of the greater Twin Cities, Minnesota and one of nine hospitals in the healthcare system. The hospital, with a staff of over 3,170 care provders, is known for outstanding heart, stroke, orthopedic and cancer care (Fairview, 2011). The hospital’s Heart, Stroke & Vascular Center is staffed by cardiologists, cardiac surgeons, vascular surgeons, interventional radiologists, interventional neuro-radiologists and neurologists who treat a wide range of heart, stroke and vascular conditions. The hospital is a national leader in survival rates for heart attacks.

The hospital's ICU is a 24-bed medical, surgical, and neurology unit. A total of 119 critical care nurses work in this ICU, and of those, 50 are specially trained in the care of the immediate post operative cardiovascular surgical patient.

Population and Sample

The population of patients simulated was the cardiac patients who have undergone coronary artery bypass with or without valve repair or replacement. The cardiovascular surgical team at Fairview Southdale performs about 320 open heart procedures per year. The surgical procedures include on and off pump coronary artery bypass grafting, thoracic aortic aneurysm repair, valve repair and replacement, valve-sparing aortic root replacement, and homograft replacement of the aortic valve and root. Two of the cardiovascular surgeons, also perform minimally invasive procedures including robotic heart surgery.

The type of surgical procedure does not affect the post operative process the patients will go through. Post operative cardiac surgery patients begin post operative recovering in the ICU directly from the OR. These patients' anesthetics are reversed just prior to the transition to ICU. They are kept intubated until they are hemodynamically stable and able to follow simple commands. Pain is controlled with intermittent boluses of pain medication delivered by the bedside nurse. Staffing of nursing care is on a one-to-one ratio, where one nurse is caring for one patient for the first eight to twelve hours of the patient's recovery in the ICU.

The *in situ* simulations involved multidisciplinary members of the cardiovascular surgical teams from both the OR and the ICU. The supervisor of the ICU was the observer for the two simulations and completed the Mayo High Performance Teamwork Scale (MHPTS) after the completion of each debriefing. The ICU team working during the shifts where the simulations took place were briefed on what would be occurring to ensure a shared mental model and to ensure safety for the patients currently in the unit. In the simulation briefing, team members were instructed to call upon the same hospital department or staff as they would during a true cardiac surgery handoff.

Production of the *in situ* simulation required the use of the “sim man” mannequin, ventilator, temporary pacemaker, transport monitor, chest tubes and drainage system, fake vasoactive medications, and a video camera. The normal paperwork from the cardiac surgery was used for participants’ reference and documentation. The *in situ* simulation started at the point of the cardiac surgery patient being rolled into the assigned ICU room to meet the ICU team. A video camera was set up in a stationary position in the ICU room.

Protection of Human Subjects

Institutional Review Board (IRB) approval was secured through Fairview Health Services and Minnesota State University, Mankato. No patients were involved in this research. Participants in the training were currently employed multi-disciplinary health care providers who were trained to care for the cardiovascular surgical patient in their identified capacity. Gender, ethnicity, and age were not factors because the sample was a convenience sample.

Instruments

Evaluation of individual and team performance was done using a pre- and post-test questionnaire (see Table 3) and the Mayo High Performance Team Work Scale during the *in situ* simulation. The pre- and post-test questionnaire was developed to assess the participant's perception of team communication and performance. The questionnaire also assessed the participants' comfort level in communicating with the team and using TeamSTEPPS communication. The questionnaire included questions assessing the participants' occupation, years of experience on the OR/ICU team, and their highest level of education. Table 3 lists the questions in both the pre- and post-test questionnaire.

Table 3.
Questions on the pre- and pos-testt questionnaire.

Questions	How answered
I understand my role as part of the OR/ICU open heart team.	5-point Likert scale
Our team's communication is effective, leading to stronger team performance.	5-point Likert scale
I feel comfortable communicating to my team members during a critical event.	5-point Likert scale
I am prepared to use closed loop communication, call outs, shared mental model and situational awareness when communicating with members of the team.	5-point Likert scale
I understand the role of each team member during a critical handoff.	5-point Likert scale
Training by simulating health care procedures will improve the level of communication between team members.	5-point Likert scale
Please indicate your occupation (circle one):	Nurse, Physician, RT, CRNA, other
Please indicate the years of experience on the ICU/OR open heart team:	Fill in the blank.
Highest education level completed related to your current position (circle one).	Associates, Bachelors, Masters, Doctorate, other

The Mayo High Performance Teamwork Scale was completed by the same observer (the ICU nurse supervisor) after the completion of each debriefing. The MHPTS offers a "range of high performance teamwork skills that are the target of crisis resource management training in medical settings" (Malec, Torsher, Dunn, Weigmann, Arnold, & Brown, 2007). Fletcher and associates (2003) have described four behaviors for evaluation in crisis resource management; cooperation/communication, leadership/management, situation awareness, and decision making (Malec, et al., 2007, p. 4). Malec, et al., (2007) used Rasch analysis to evaluate the reliability and validity of the MHPTS scale. It demonstrated satisfactory reliability, construct validity, and sensitivity to change.

Each simulation was videotaped and the video tape watched by the participants in its entirety during the debriefing. The participants were asked to identify what went well, what could have gone better, and what they would do differently in the future before they watched the simulation. The TeamSTEPPS communication style used during the simulation were identified to allow further learning to occur. The video tape was stopped at times to discuss the behavior or communication occurring and to allow for further discussion.

Data Collection

The student investigator gave all participants a consent form during the briefing. During this initial briefing, the persons who signed the consent form indicating their willingness to participate were given the pre-test questionnaire to complete. The post-test questionnaire was given to the participants at the beginning of the debriefing session, and participants were asked to complete it at the end of the debriefing.

All data during the pilot study was collected and tracked by the student investigator. Results were recorded on an Excel spreadsheet using only the identification numbers randomly assigned to each participant. All complete questionnaires were kept in a locked cabinet in the student investigator's office.

The handoff of care of the cardiovascular surgical patient from the OR team to the ICU team was recreated using high-fidelity simulation. Team members were educated on TeamSTEPPS communication via an e-learning module, which incorporated a video tape on the ideal handoff. Participants were tested pre- and post-simulation on their perception of team communication and performance. A briefing to explain the simulation and a debriefing reviewing the video tape of the simulation was facilitated by the student investigator. Using the MHPTS, an observer rated the overall team performance during each simulation.

CHAPTER IV

RESEARCH FINDINGS

This pilot study employed a quantitative approach and descriptive statistics were the primary means of analysis. The results from the two pilot groups' pre- and post-test questionnaires were evaluated using a paired *t-test*. Team performance was measured using the Mayo High Performance Team Work Scale.

Description of the Sample

A total of two *in situ* simulations were completed. The first simulation had five participants; two ICU nurses, one OR nurse, one RT, and one CRNA. The average years of experience on the combined ICU/OR cardiovascular surgical team was 10.4 years with a standard deviation of 12. The highest degree level attained by any of the participants in this simulation was a Master's degree.

The second simulation included six participants; two ICU nurses, one OR nurse, one RT, one CRNA, and one surgeon. The average years of experience on the combined ICU/OR cardiovascular surgical team was 15.3 years with a standard deviation of 8.4. A MD degree was the highest degree attained by any of the participants in this simulation. A summary of the demographic characteristics is presented in Table 4.

Table 4

Demographic characteristics of simulation groups.

Characteristic	**Simulation 1**	**Simulation 2**
Experience on the ICU/OR open heart team	10.4±12.0 (5) (2.0, 31.0)	15.3±8.4 (6) (3.0, 25.0)
Occupation		
Nurse	60% (3/5)	50% (3/6)
Physician	0% (0/5)	17% (1/6)
Respiratory Therapist	20% (1/5)	17% (1/6)
CRNA	20% (1/5)	17% (1/6)
Other	0% (0/5)	0% (0/6)
Highest education level		
Associate	60% (3/5)	67% (4/6)
Bachelors	20% (1/5)	0% (0/6)
Masters	20% (1/5)	17% (1/6)
MD	0% (0/5)	17% (1/6)
Other	0% (0/5)	0% (0/6)
Numbers are Mean±SD (N) (Minimum, Maximum) or % (Count/Sample Size).		

Findings/Results

Pre- and Post-Test Findings

In this pilot study, each subject completed both pre- and post-test questionnaires. Responses to pre- and post-test questions were evaluated for each of the two simulations. In addition, the data were combined for both simulations and analyzed. For the first six questions, subjects were required to answer using a 5-point Likert scale ranging from 1= “strongly disagree” to 5= “strongly agree”. A summary of the pre- and post-test questionnaire results are presented in Table 5.

Table 5

Combined pre and post questionnaire results (data from both simulations)

Question #	**Difference* (PostTest-PreTest)**	**95% Confidence Interval for the Mean Difference**	***p*_value****
1	0.18± 0.60 (11) (0.00, 2.00)	[-0.22, 0.59]	0.340
2	0.18± 0.75 (11) (-1.00, 1.00)	[-0.32, 0.69]	0.440
3	0.09± 0.54 (11) (-1.00, 1.00)	[-0.27, 0.45]	0.588
4	0.27± 0.47 (11) (0.00, 1.00)	[-0.04, 0.59]	0.081
5	0.18± 0.40 (11) (0.00, 1.00)	[-0.09, 0.45]	0.166
6	0.09± 0.30 (11) (0.00, 1.00)	[-0.11, 0.29]	0.340

* Numbers are Mean±SD (N) (Minimum, Maximum)
*******p*_values from paired t-test are presented

A paired t-test was used to analyze the mean difference between the pre- and post-test scores. The 95% Confidence Interval for the mean difference on each question and the corresponding *p*-values were given. The results for all subjects (combined simulation one and two) appeared in Table 5. The results for subjects from simulation one and two were provided in Tables 6 and 7, respectively.

As shown in Table 5, question #1 stated, “I understand my role as part of the OR/ICU heart team.” The mean difference between pre-test and post-test scores was 0.18 with no statistically significant difference between the two (*p*_value = 0.34). In simulation one, a subject circled in between two of the numbers used to represent the 5-point Likert scale. This value was labeled as “undef” as seen in Table 6.

Question #2 stated, “Our team communication is effective, leading to stronger team performance.” The mean difference of 0.18 between the pre- and post-test scores was not significant (*p*_value = 0.440). Question #3 stated, “I feel comfortable communicating to my team members during a critical event." The mean difference between pre- and post-test scores of 0.09 (*p*_value = 0.588).

Question #4 stated, "I am prepared to use closed loop communication, call outs, shared mental model, and situational awareness when communicating with members of the team." To facilitate this preparation, each subject was asked to complete the e-learning module where these styles of communication were clearly discussed. The video in this e-learning module highlighted when these communication styles were used throughout the handoff. The mean difference between pre-test and post-test scores was 0.27, with no statistically significant difference found (*p*_value = 0.081). Question #5 stated, "I understand the role of each team member during a critical handoff." The mean difference between pre- and post-test scores was 0.18, which was not statistically significant (*p*_value = 0.166). Question #6 stated, "Training by simulation of health care procedures will improve the level of communication between team members." The mean difference was 0.09 between the pre- and post-test scores, again showing no significant statistical difference (*p*_value = 0.340).

Table 6

Simulation one pre and post results.

Question #	**Difference* (PostTest-PreTest)**	**95% Confidence Interval for the Mean Difference**	***p*_value****
1	0.00± 0.00 (5) (0.00, 0.00)	[0.00, 0.00]	Undef
2	0.00± 1.00 (5) (-1.00, 1.00)	[-1.24, 1.24]	1
3	0.40± 0.55 (5) (0.00, 1.00)	[-0.28, 1.08]	0.177
4	0.20± 0.45 (5) (0.00, 1.00)	[-0.36, 0.76]	0.373
5	0.20± 0.45 (5) (0.00, 1.00)	[-0.36, 0.76]	0.373
6	0.20± 0.45 (5) (0.00, 1.00)	[-0.36, 0.76]	0.373

* Numbers are Mean±SD (N) (Minimum, Maximum)
**_p__values from paired t-test are presented

Table 7

Simulation two pre and post results.

Question #	**Difference* (PostTest-PreTest)**	**95% Confidence Interval for the Mean Difference**	***p*_value****
1	0.33± 0.82 (6) (0.00, 2.00)	[-0.52, 1.19]	0.363
2	0.33± 0.52 (6) (0.00, 1.00)	[-0.21, 0.88]	0.174
3	-0.17± 0.41 (6) (-1.00, 0.00)	[-0.60, 0.26]	0.363
4	0.33± 0.52 (6) (0.00, 1.00)	[-0.21, 0.88]	0.174
5	0.17± 0.41 (6) (0.00, 1.00)	[-0.26, 0.60]	0.363
6	0.00± 0.00 (6) (0.00, 0.00)	[0.00, 0.00]	Undef

* Numbers are Mean±SD (N) (Minimum, Maximum)
**_p__values from paired t-test are presented

In conclusion: the analysis showed for each question that the differences in pre-test and post-test scores were not statistically significant.

MHPTS Findings

The results of the MHPTS were significantly better for simulation one than simulation two. Simulation one generated "consistently" for all qualities evaluated by the scale, whereas simulation two generated "inconsistently" for all qualities evaluated. The same observer completed the MHPTS for each simulation. This observer had no training in crisis resource management. Malec, Torsher, Dunn, Wiegmann, Arnold, Brown, et al. (2007) found that the MHPTS can be "used with reasonable reliability even by naïve raters" (p. 10). Notes from the observation section may speak to these results. Participant engagement were much higher in simulation one than two. One of the participants in simulation two spoke skeptically about the simulation and its comparison to real clinical practice.

Observations/Debriefing Notes

Notes and observations taken during the simulations and debriefings were documented. For simulationone, the primary ICU nurse stated they were able to continue to perform tasks as the CRNA gave report. The CRNA felt this was distracting and that important patient information was not being heard. However, the CRNA waited for the primary nurse to complete the initial assessment and stated this timeframe "felt like forever." Documentation would normally need to be completed, but it was unclear where to do this during the simulation. The circulating nurse felt there was no extra information needed in handed off that the CRNA would not cover in report. The circulating nurse asked what patient information would be beneficial to the ICU team to assist in the handoff. Strong team discussion occurred during the debriefing with little to no facilitation by the student investigator. The team members acted engaged and spoke in positive tones throughout the discussions.

The CRNA and the circulating nurse, who attended the first simulation, stated they had not completed the e-learning module. Immediately prior to the briefing these two participants watched the handoff video that was part of the e-learning module.

During the first simulation debriefing, the ICU nurses noted deviations from actual practice. For example, the nurses noted the inability to hear the QRS tone on the monitor, which is always present when a patient is being settled. The CRNA noted that usually they have the medication Amicar infusing when they bring each cardiac surgical patient to the ICU. They also have the medications Epinephrine and Nitroglycerine hanging on the IV poles in case they need them.

The second simulation observations and notes included that the ICU nurses appreciated the surgeon giving a brief history of the patient during the handoff. They both felt this was helpful in better understanding the patient they were settling. The second debriefing did not have as deep of discussion as the first simulation debriefing. The CRNA who participated in this simulation spoke skeptically about the simulation and its comparison to true clinical practice. The CRNA stated it did not feel like a good representation of the real situation and, therefore, it was difficult to function as they normally would. The CRNA sat outside of the circle of team members during the debriefing and did not offer comments unless asked. When spoken too, the CRNA responded with comments that were negative or defensive in nature. The circulating nurse in this simulation spoke to not knowing what information was needed from her by the ICU team. The ICU nurses felt that any identified patient skin issues would be details important for them to know, along with any outstanding labs needing to be completed or pending results. It was noted that much less closed loop communication was used among the group during this simulated handoff. The surgeon spoke to the group about the great improvement seen in the handoff of these patients over the last few years since *in situ* simulations have been implemented.

The CRNA and circulating RN stated they had not completed the e-learning module. Immediately prior to the briefing, the CRNA watched the handoff video that was part of the e-learning module.

The ICU nurses noted that the patient's chest tubes were not banded. They stated that this was almost always done on these patients. Both of the OR team members discussed items that they usually transport with each cardiac surgical patient and that were not present in the simulation. A blood cooler, and an oxygen tank are usually transported, and the transport monitor is usually on the bed not on a pole.

Summary of Findings

The first research question being studied asked whether educating team members on effective communication styles through e-learning would affect their perception of team communication and performance. The second research question asked whether this education would affect team member's perception of their ability to use this communication in clinical situations. Of the survey questions asked, questions two "our team communication is effective, leading to stronger team performance" and four "I am prepared to use close loop communication, call outs, shared mental model, and situational awareness when communicating with members of the team" most closely related to these research questions.. Although not statistically significant, improvement was noted from pre to post simulation responses to both questions.

Research question three asked "when using the MHPTS, does the team perform consistently after receiving education through e-learning on effective communication styles?" The first simulation did show that the team performed consistently on all dimensions of the scale; however, the second simulation showed the team performed inconsistently on all dimensions rated. In the second simulation, the CRNA expressed feeling uncomfortable performing during the simulation. A negative attitude was noted from the CRNA, who responded to discussion questions defensively.

The purpose of this pilot study was to improve team communication during the critical handoff of the cardiac surgical patient from the OR team to the ICU team and to establish a reliable framework in which TeamSTEPPS communication could be used consistently in the handoff of care of the cardiovascular surgical patient.

Limitations

Several limitations can be identified in this pilot study. First, only two simulations were conducted and evaluated. More simulations are needed to identify a significant difference in pre- and post-simulation responses. Second, despite *in situ* simulation being considered a high-fidelity training strategy and the clinical scenario being created to replicate the real experience, features were missing that may have affected team performance. The poor completion rate of the e-learning module is a further limitation. Despite each participant watching the video of the ideal handoff, the full content of the module was not viewed and limited the results of this pilot study. The last limitation was the inconsistent composition of the cardiovascular surgical team. Despite this being a known limitation, the loss of a team member may drastically affect the overall team ability to communicate and perform.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Summary

The safety of a hospital is difficult to measure correctly and is often overestimated. Medical errors and adverse events continue across all health care systems. Often, research is done by team members in organizations that are already devoted to patient safety. Participation at a team level is difficult to accomplish, and those who take part may convey attitudes, behaviors, and culture already uncharacteristic of the norm, leading to decreased generalizability of the findings. While extensive research has been done on patient safety initiatives, the sustainability of these initiatives and their long-term success needs to be further studied.

In situ simulation training occurs on actual patient care units and involves health care team members carrying out organizational processes. This high fidelity training allows for recreation of demanding critical events that take place in the heath care environment. Successful team training initiatives require meticulous groundwork for realization. The simulation developed to improve the cardiac surgical team communication and performance in this pilot study was designed to supply the essential competencies for both the individual participants and the teams to conduct the safest handoff of care possible. Local interventions like these, done for patient safety, have great success, but more widespread adoption is needed to have a greater impact on patient safety in health care.

Discussion of Findings

A statistical significance between pre- and post-test perceptions of competence was not demonstrated in this pilot study. Despite that, improvements were seen post-simulation in the participants' perceptions of the team communication and performance, as well as their perceptions of the ability to perform the identified communication styles within the team. Most participants felt training through simulation will assist in improving team communication. Clearer understanding of their role was also seen in some participants' post surveys. It is expected that the learning will translate into improved team function in future clinical situations.

With further research using the methodology of e-learning and *in situ* simulation, can a significant difference be demonstrated pre-simulation to post-simulation in the participants' perceptions of communication and team performance? It can be maintained from this pilot study that those who participate in *in situ* simulation will have an improved perception of their ability to communicate within a team. Participants of *in situ* simulation may also have improved role clarification. There may also be preexisting factors influencing the individual and team performance of participants such as, previous involvement in simulation training, current communication skill level, professional engagement, and organizational commitment. Factors such as these may have profound positive or negative influences on the participants' performance during simulation training.

A participant's comfort level with speaking up during a critical event may go beyond their confidence level in their practice. Organizations that practice just culture encourage and support open communication at all levels of the organization. Through tracking certain behavioral markers, organizations can track their growth in the culture (About our community, 2011).

Does one participant's attitude and response toward the clinical situation affect the teams overall communication and performance? Observation of team performance through use of the MHPTS is useful for documenting each individual team member's attitude and participation. In particular, one dimension in this scale speaks to the involvement of each team member in the activity. Fanning and Gaba (2007) wrote that a good deal of the research on teaching adults has pointed out that "active participation" is an important aspect in increasing the effectiveness of learning (p. 115). This was evident in simulation two when the CRNA spoke skeptically about the simulation and sat outside of the circle of team members during the debriefing, offering no comments unless asked. Any comments from the CRNA were negative or defensive in nature. This type of negative participation may have influence the overall team, which was shown to have low participant engagement in simulation two and inconsistent team performance on the MHPTS scale.

Implications for Nursing Practice

Nursing is continually working to improve patient safety. This research incorporated the use of *in situ* simulation training, which occurs on actual patient care units to improve nursing participation in patient safety. The findings of this pilot study may help to further understand how teams communicate and perform during critical situations. The findings support appreciation that the technical skills of team members may be secondary to the non-technical skills, such as communication, in the performance of highly reliable teams. Solet, et al. (2005) found almost "80% of serious medical errors involve miscommunication" between providers during the handoff of care (p. 1095).

An accurate understanding of how interdisciplinary teams function is needed to improve patient safety. Nurses are often a constant on these interdisciplinary teams and play a crucial role in assuring successful team performance through the communication of critical information. Through the use of *in situ* simulation, the non-technical skills of nursing can be examined and areas of concern identified. This practice may assist nurses in identifying important clinical cues and effectively communicate to other team members their situational awareness, which will allow the team to have a shared mental model.

Implications for Nursing Research and Education

In situ simulation training was applied to the regular practice of care handoff and simulation training can improve patient safety through improvement of interdisciplinary team reliability and effective communication and performance. A shared communication framework must be established so that when distractions and deviations occur, the process works to assure consistency and patient safety.

Simulation training can be employed in high-risk handoffs and clinical situations within healthcare, such as code blues, rapid response teams, emergent intubations, and other high-risk bedside procedures. Many high-risk handoffs occur infrequently, making them ideal for simulation work to improve team members' comfort level. The same team makeup rarely occurs in health care due to the high number of participants who function in each role. By training with simulation, team members can learn clear role definitions and communication styles that improve team performance, ensuring patient safety.

Multiple lessons from this pilot study can be taken forward to further improve simulation training and the participants' experience. Environmental aspects of this particular handoff situation were identified for improvement, including the need for a blood cooler, an oxygen tank, and the correct positioning of the transport monitor on the patient's bed during the simulation. Certain medications will also be added to this patient scenario for future simulations. These medications include Amicar, Epinephrine, and Nitroglycerine. The addition of these items will improve the participants' perceptions of the reality of the cardiovascular surgery patient handoff in future simulation sessions. Bringing simulation to the patient care unit demonstrates that with proper planning successful simulation training can be performed outside of a controlled laboratory setting (Kobayashi et al., 2008; Weinstock et al., 2009).

Further exploration of ideas to engage participants in simulation-based training are needed. This pilot study clearly demonstrated the effects one participant's perception of simulation can have on the team experience as a whole. Are there ways to better prepare the participants for what simulation training will entail along with the importance of walking through these critical patient scenarios in controlled, safe settings? Can further facilitator training help improve the participants' reflection process? The ability to reflect, appraise, and reappraise is a key component of lifelong learning in any setting, and particularly in *in situ* simulations.

Meticulous nursing education, licensure, and professional standards ensure high performance of technical skills in the nursing profession. Team skills around the influences of human factors are at more undeveloped levels and can be further advanced with the addition of simulation-based training at the entry level of nursing. With simulation-based education, nurses would enter practice with a better understanding of communication within a team, as well as how reflection can positively influence the advancement of their practice and performance.

Further simulation-based training around high-risk patient care handoffs is possible using portable simulation training. Incorporation of simulation in educational programs, including nursing, can improve team communication, assist in achievement of high-reliability practices, and improve patient safety.

Conclusions

With further simulations added to this pilot study, the findings of this research may contribute to the body of teamwork research and further provide insight into team communication and function. These results suggest that additional individual education on communication and team training through simulation may help to ensure safe patient handoff in critical clinical situations.

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